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SHORT RANGE SIMULTANEOUS COMMUNICATION SYSTEM

by

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Communications and Electronics Branch

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Final Report

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report describes tests and evaluation of the Bendix "Multicom" Communication System. The system operates with an open microphone arrangement which provide hands-free operation without using VOX circuits. Tests conducted indicate only a very short communications distance between stations (approximately 130 meters) is obtainable.		

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INTRODUCTION

During the 1970-1971 time frame, the Bendix Communications Division announced the development of a unique technique for short range radio communications. The system, which is called "Multicom", allows the individual station transmitters and receivers to operate simultaneously. Neither voice operated switches (VOX) nor push-to-talk switches are necessary. All stations in the net receive and retransmit all of the signals from all of the other stations. This gives the effect of each station acting as a synchronized repeater or relay ($F_1 - F_1$). The net results are very similar to a telephone conference call. The U S Army Land Warfare Laboratory procured four (4) of the Multicom sets to evaluate their usefulness for civil disturbance and urban conflict applications in which a need for "hands-free" communications had been identified.

SYSTEM DESCRIPTION

Multicom Model 457C, the system tested, operates at a frequency of 27.12 MHz. Transmitter power is a few milliwatts and the modulation is FM pulse modulation. The receiver is a super-heterodyne. The transmitter-receiver with batteries measures 1" x 3" x 6" and weighs about 11 ounces. Power is provided by two TR-133 mercury batteries which will operate the set for 6-8 hours (see Figure 1).

The headphone-microphone assembly also supports the transmitting antenna which is made of spring wire about 24 inches long. The headphone cord acts as the receiving antenna. The headphone-microphone assembly weighs about 12 ounces.



Figure 1. Short Range Communication System,
Multicom Model 457C

SYSTEM OPERATION

The system employs two principles in operation: the use of a variable-repetition-rate pulse train for voice transmission and the use of a frequency-modulated master oscillator (operating at nominally 12 KHz) that is phase-locked to both transmitted and received pulses.

The voice information is transmitted as a string of constant-amplitude, 20 microsecond pulses on which the modulation has been impressed by varying the time between pulses - in essence, pulse frequency modulation.

These pulses can be transmitted as 20 microsecond bursts of an RF carrier. The present system, designed for short-range communications (up to several hundred feet) operates in the 27 MHz band with an average power output of 5 milliwatts.

The uniqueness of the system lies in the fact that the pulses not only contain the voice modulation, but are also used for both local and remote phase-lock control of the 12 KHz master oscillators - which, in turn, regenerate 20 microsecond pulses in step with the local or received modulation.

For each cycle of the 12 KHz oscillator, a 20 microsecond pulse is generated and applied to a diode switch, which gates the output of a VHF crystal oscillator. The diode switch output is a 20 microsecond burst of RF that is applied to the transmitter amplifiers, which apply the burst to the antenna.

The transmitted pulse rate, with no modulation, is determined by the free-running frequency of the 12 KHz oscillator. When not receiving pulses from another transmitter, the set feeds its own pulses back through its receiver and around a closed loop to the 12 KHz oscillator input to establish a stable oscillator rate.

Each station's own transmitted pulses are always present at its receiver input, but this does not interfere with reception of pulses that are ahead of or behind it, because the receiver has been especially designed with a recovery time of about 0.020 microseconds.

When a second station is operating in the vicinity, it transmits its own string of 20 microsecond pulses. The receivers in both stations detect early or late arrivals of the incoming pulses with respect to their own pulses, applying a correcting signal to their own oscillators that tends to correct the error. The signals from both transmitters lock into synchronism and the 12 KHz oscillators in both sets become phase-locked at some frequency that is a compromise between the free-running rates of both. When more stations are added to the loop, they all synchronize their pulse transmissions at some common, compromise frequency.

When anyone speaks into the microphone, the 20 microsecond pulses are generated at a rate which varies in synchronism with the modulation frequencies. The pulse train passes through a triple integrator and the voice signal is recovered. This signal is amplified and applied to the earphones. These same pulses are also transmitted as the RF bursts, which are received and locked onto by the other sets in the vicinity.

RANGE LIMITATIONS

A maximum range of about 300 meters is theoretically obtainable with this system because this distance represents a 1 micro-second time delay which, if exceeded, begins to cause difficulty in the phase-locked oscillators.

TEST RESULTS

Tests conducted at Aberdeen Proving Ground, MD indicated that about 130 meters between stations was the maximum distance for reliable communications outdoors. In building, about 50 to 70 meters was possible. Using more than two stations increased the overall range. Experiments were conducted to determine if additional transmitter power would increase the range. The results of increasing the power to about 2 watts gave only about a 30% increase in range. A quarter wave antenna (105") was also tried to improve the results, but the improvement was not worth the increased length (the original whip was about 24" long). Except for its short range, the system performed very well.

CONCLUSIONS

1. The Multicom system provides reliable "party-line", hands-free communications among many stations.
2. The system tested was limited in communications range to about 130 meters, approximately one-third of the theoretical maximum.
3. The present headphone-microphone-antenna assembly is not suitable for military use.
4. Due to the unique modulation technique employed, the system will not net with tactical military radio systems.
5. The Multicom System appears to be feasible for the following typical applications: military or civil police engaged in crowd control, firefighter activities, convoy intracomunications, airport-heliport ground crew operations, artillery gun crew communications, and patrol boat crew communications.

RECOMMENDATION

If a military requirement for a communications system employing the Multicom technique develops, consideration should be given to a 450 MHz version which would allow the use of a very small resonant antenna which could be incorporated with the headphone-microphone assembly.

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